Development of Risk Assessment and Handling Model With Integration of Multi Criteria Decision Making and House of Risk Multi Actor aat Denso Neo Autokool Surabaya Workshop

Steven Jonathan Soecipto[1,*] Evy Herowati[2,] Rosita Meitha Surjani[2]

[1]*Faculty of Business and Economics, Universitas Surabaya, Indonesia*
[2]*Faculty of Engineering, Universitas Surabaya*
[*]*Corresponding author. Email: stevenjonathan13@gmail.com*

ABSTRACT
This study focuses on eliminating the potential failures faced by the company. Denso Neo Autokool Surabaya has identified the existence of risks but has not taken any measures to mitigate them. This research proposes a risk management approach based on the integration of Multi-Criteria Decision Making (MCDM) and the House of Risk (HOR) Multi-Actor method. The integration of these two methods aims to improve the quality of preventive action (PA) selection. From the study, it was found that there are 14 Risk Events (RE) and 22 Risk Agents (RA). The results of the integration of MCDM and HOR Multi-Actor Phase 1 yielded 8 RA out of 22 RA with a cumulative percentage of 80%, along with their corresponding preventive actions (PA).Nine identified preventive actions (PA) were further analysed using HOR Multi-Actor Phase 2 and weighted again using Pairwise Comparison and the Best Worst Method (BWM) to determine the best method for weighting. The final weighting results were submitted to the company's management for decision-making. Out of the 9 proposed preventive actions, 6 were prioritized in HOR Multi-Actor Phase 2 with a cumulative percentage of 80%.The top-priority PAs are: PA 8: Designing a performance evaluation system for mechanics based on clear and relevant KPIs. PA 5: Conducting regular mechanic training to enhance skills and performance. PA 1: Developing educational promotional media in the form of images and videos.

Keywords*: Best Worst Method, House of Risk Multi Actor, Multi Criteria Decision Making, Preventive Action, Risk Events, Risk Agents,*

1. INTRODUCTION

PT. Denso Neo Autokool Surabaya is a vehicle repair service provider specializing in car air conditioning repairs. In this competitive service sector, operational delays or negligence can lead to significant corporate losses. While the workshop management is aware of potential business risks, concrete mitigation efforts have not yet been implemented. Therefore, an analysis is necessary to manage business process risks by considering both customer and company interests through a multi-actor approach. Risk management is an essential component that identifies, evaluates, and reduces potential threats to increase process effectiveness **(Arifudin et al., 2020a)**, enabling companies to anticipate losses and continue innovating in a competitive market **(Darmawi, 2006)**. To address these challenges, this study integrates Multi-Criteria Decision Making (MCDM) and the House of Risk Multi-Actor (HOR Multi Actor) framework. MCDM is used to assign weights and select alternatives based on predefined criteria **(Nasution & Amin, 2023)**, allowing for more accurate weighting of criteria and alternatives **(Ristanovic, 2023)**. Concurrently, HOR Multi Actor identifies, assesses, and provides appropriate mitigation suggestions **(Herowati et al., 2023)**. In this research, the Best Worst Method (BWM) is utilized for weighting risk events (RE), risk agents (RA), and preventive actions (PA) due to its advantages in quick calculations and providing better consistency compared to Pairwise Comparison **(Mi et al., 2019)**.

The objectives of this study are:

1. To identify and analyze the sources of risk at Denso Neo Autokool Surabaya.
2. To integrate MCDM and HOR Multi Actor methods to select risk agents and risk mitigation actions.

3. To determine the priority of risk mitigation strategies to address the risk sources at the workshop

2. RESEARCH METHODS

The conceptual framework of the research is systematically developed based on the ISO 31000:2018 framework as the main reference to achieve the research objectives in an organized manner. The research methodology stages are divided into three major parts:

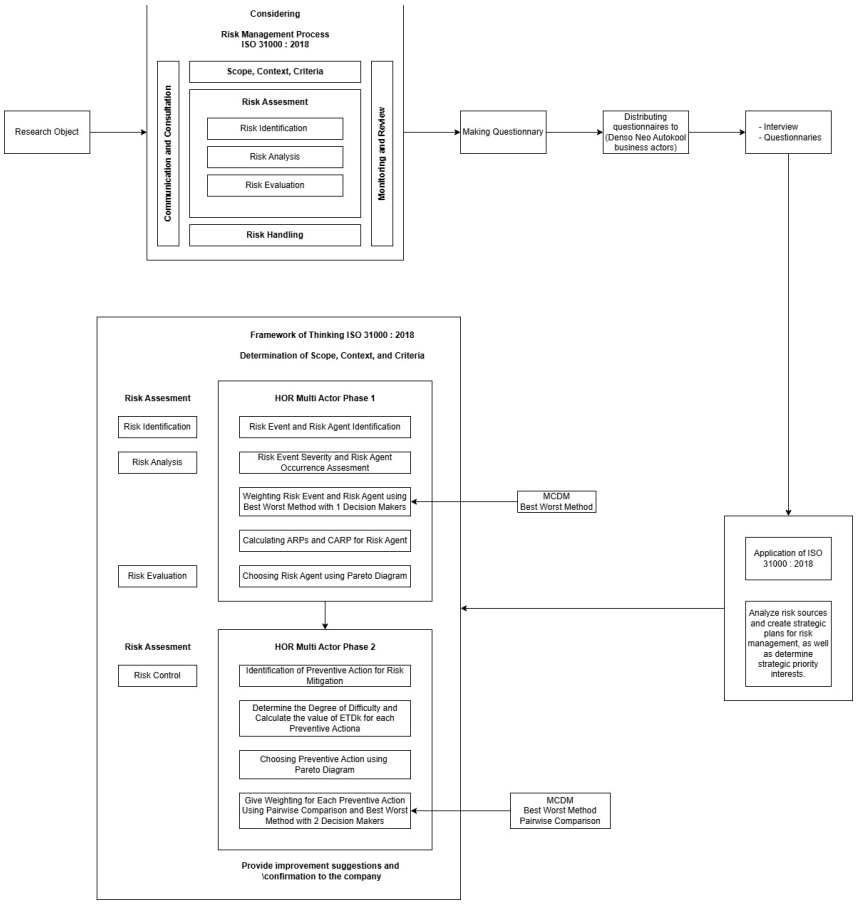

Figure 1 ISO 31000:2018 framework

I. Risk Assessment (ISO 31000:2018 and HOR Multi Actor Phase 1)

1. Risk Identification: Identifying Risk Events (RE) and Risk Agents (RA) by relevant actors as presented in Table 1.
2. Risk Analysis: Assessing the level of risk occurrence for each RA and the severity of the risks (Risk Severity) on both customers and the company.
3. Risk Evaluation: Calculating the CARP (Combined Actor Risk Priority) value for each RA, which is the sum of the customer ARP (Actor Risk Priority) and company ARP based on the weighting values derived from the Best Worst Method for RE and RA. The Pareto Principle is applied to filter RAs based on the highest CARP values, followed by sorting with a cumulative 80% threshold.

II. Risk Treatment (HOR Multi Actor Phase 2)

Identifying Preventive Actions (PA) through benchmarking, cross-benchmarking, discussions with workshop managers and automotive service practitioners; assessing the PAs based on the level of implementation difficulty and their correlation with the Risk Agents, resulting in a prioritized list of PAs.

III. Selected PAs

The selected PAs are re-evaluated using both the Pairwise Comparison and Best Worst Method to determine the most feasible PAs for implementation, while also identifying the most effective and efficient weighting evaluation method.

3. RESULT AND DISCUSSIONS

Based on the results of observations, interviews, and customer review analysis, a total of 14 Risk Events (RE) and 22 Risk Agents (RA) were successfully identified. The following are **examples** of the relationships between REs and RAs based on the impacted actors

3.1 Risk Assessment (ISO 31000:2018 and HOR Multi Actor Phase 1)

Table 1. Risk Event and Risk Agent Based on Impacted Actors

Risk Event	Impacted Actors	Description	Risk Agent	Description
RE1	Company Management,Workshop Head, Mechanics.	Demand for salary increases and incentives.	RA1	Increase in wage rates from the government.
			RA17	There is no performance appraisal system that takes into account employee performance.
RE2	Company Management,Workshop Head.	Public response to Denso Neo Autokool which can only provide Air Conditioner repairs.	RA2	Public responses or myths that are still difficult to eliminate.
RE3	Company Management,Workshop Head.	The number of cars undergoing repairs is lower than the repair capacity.	RA3	Lack of promotional media that can attract consumer interest.
RE4	Company Management,Workshop Head.	There is no increase in sales or market entry	RA4	Denso spare part prices are more expensive than other brands
RE5	Company Management,Workshop Head, Mechanics.	Cannot repair electric and hybrid cars	RA5	Lack of qualified human resources to repair electric and hybrid cars.
			RA6	There is no employee training schedule for electric and hybrid cars yet.
			RA7	There is no tools to handle electric and hybrid cars
			RA8	There is no procurement of tools to handle electric and hybrid cars.
RE6	Company Management, Customers.	Vehicle repairs that were not carried out properly.	RA20	Mechanical negligence in carrying out repairs.
RE7	Workshop Head.	Mechanic not coming to work	RA9	Sick mechanic
			RA10	Mechanic goes on leave
			RA11	The mechanic is not looking for a replacemen

Based on the previously identified risks, a risk assessment can be carried out. Risk events (RE) will be assessed based on their severity, while the causes of risk events (RA) will be assessed based on their occurrence. RE and RA assessments are related to the actors affected by each RE and RA. After assessing the severity and occurrence, RE and RA will be weighted using the best-worst method with the decision maker being the workshop head. The weights of RE and RA will be used in the House of Risk Multi Actor Phase 1. The use of the best-worst weight method functions as

an integration effort that is carried out, so that the selected RA is an RA that has considered the severity, occurrence, value of the RE-RA relationship and the interests of the workshop head.

			Risk Agent (Aj)																						
		Bobot RA	0,07	0,07	0,11	0,35	0,09	0,11	0,36	0,05	0,11	0,03	0,11	0,07	0,07	0,14	0,09	0,09	0,09	0,18	0,18	0,39	0,18	0,07	Management Severity	Costumers Severity
	Bobot RE	RE/RA	RA 1	RA 2	RA 3	RA 4	RA 5	RA 6	RA 7	RA 8	RA 9	RA 10	RA 11	RA 12	RA 13	RA 14	RA 15	RA 16	RA 17	RA 18	RA 19	RA 20	RA 21	RA 22		
Risk Event (Ei)	0,43	RE 1	9																9						9	
	0,12	RE 2		9	3									3										1	7	
	0,12	RE 3			3	3								3						1		3			7	
	0,12	RE 4			3	9															1				7	
	0,09	RE 5					9	9	3	9															5	
	0,58	RE 6					1	1	1	1					3	1	1	1		1		9	1	1	3	1
	0,05	RE 7									9	9	9												3	
	0,16	RE 8			3	3								9								3			5	
	0,16	RE 9													9										5	
	0,21	RE 10														9	9								7	
	0,54	RE 11														3	9	9							9	
	0,11	RE 12														3	3			9	9					3
	0,16	RE 13																					9	9	3	3
	0,16	RE 14													3		3					9			3	1
	Occurrence		7	7	7	9	5	5	3	3	3	3	3	7	5	3	3	3	7	1	1	3	1	3		
	Company ARP		242	53,8	70,81	114	28,3	28,3	9,13	17	3,726	3,73	3,73	86,9	69,2	89,32	176,6	136,2	242	2,591	0,85	74,67	6,003	20,57		
	Costumers ARP		0	0	0	0	2,9	2,9	1,74	1,74	0	0	0	0	11,1	4,572	5,994	1,737	0	3,414	2,84	19,9	4,845	14,54		
	CARP		242	53,8	70,81	114	31,2	31,2	10,9	18,7	3,726	3,73	3,73	86,9	80,2	93,89	182,6	137,9	242	6,005	3,69	94,57	10,85	35,11		
	CARP x RA Weight		17,6	3,928	7,719	39,7	2,84	3,55	3,95	0,84	0,406	0,12	0,41	6,34	5,86	13,52	16,62	12,55	22	1,075	0,66	37,17	1,942	2,493		

Figure 2. Best Worst Method and House of Risk Multi Actor Integration.

Applying the 80% Pareto threshold to the CARP scores narrowed the 22 initial Risk Agents down to **8 critical RAs** requiring immediate mitigation

Table 2. Prioritized Risk Agents from HOR Phase 1

Code	Risk Agent
RA 4	Denso spare part prices are more expensive than other brands
RA 20	Negligence of mechanics in carrying out repairs.
RA 17	There is no mechanical performance appraisal system that takes into account mechanical performance.
RA 1	Increase in wage rates from the government.
RA 15	*Tools are damaged.*
RA 14	The number of tools is not many.
RA 16	No tools were returned to Denso headquarters to obtain replacement tools.
RA 3	Lack of promotional media that can atract consumer interest.

Through internal managerial discussions and benchmarking with automotive experts, 9 Preventive Actions (PA) were formulated to counteract the 8 critical RAs

Table 3. Formulated Preventive Actions

Code	Preventive Action
PA 1	Designing educational promotional media for consumers in the form of images and videos
PA 2	Implementation of membership on consumers.
PA 3	Create an inventory plan for the most frequently used tools.
PA 4	Improvement of SOP for tools repair
PA 5	Conduct regular training for mechanics to improve skills in carrying out repairs.
PA 6	Design a fine system for every negligence made by mechanics.
PA 7	Create SOP for returning tools.
PA 8	Design a mechanical performance assessment system based on clear and relevant KPIs (Key Performance Indicators).
PA 9	Providing incentives for mechanics with the best performance.

3.2 *Risk Treatment (HOR Multi Actor Phase 2)*

Risk Agent	*Preventive Action*									CARP
	PA 1	PA 2	PA 3	PA 4	PA 5	PA 6	PA 7	PA 8	PA 9	
RA 1										17,63
RA 3	9	9								7,719
RA 4	9	9								39,71
RA 14			9	3	9	9	9			13,52
RA 15			3	9	9	9	9			16,62
RA 16			3	9	3	3	9			12,55
RA 17					9	3		9	3	21,98
RA 20				9	9	3	3	9	9	37,19
Dk	3	3	3	3	3	5	3	4	4	
Tek	427	427	209	638	841	486	496	533	401	
ETDk	142	142	69,7	213	280	97,3	165	133	100	

Figure 3 House of Risk Phase 2

After HOR Phase 2 processing, 6 PAs fell within the 80% Pareto threshold. These were re-weighted based on two decision-makers: the Workshop Head (40% weight) and Company Management (60% weight).

3.3 *Selected PAs*

Table 4. Final Weighting Results using Pairwise Comparison

Code	Workshop Head 40 %	Company Management 60%	Final Weight	*Pairwise Rank*
PA 1	0,260	0.204	0.224	**2**
PA 2	0,046	0.051	0.293	**6**
PA 4	0,105	0,119	0.406	**5**
PA 5	0,094	0,297	0.387	**3**
PA 7	0,109	0,119	0.441	**4**
PA 8	0,384	0,208	0.682	**1**

Table 5. Final Weighting Results using Best Worst Method

Code	Workshop Head 40 %	Company Management 60%	Final Weight	BWM Rank
PA 1	0,262	0,148	0.185	**3**
PA 2	0,033	0,053	0.043	**6**
PA 4	0,087	0,111	0.101	**5**
PA 5	0,075	0,379	0.198	**2**
PA 7	0,131	0,089	0.103	**4**
PA 8	0,412	0,221	0.283	**1**

BWM was selected as the optimal weighting model because it required significantly fewer pairwise comparisons, simplified data collection, and yielded a superior (lower) consistency ratio.

4. CONCLUSION

This study successfully mapped the operational risk profile of Denso Neo Autokool Surabaya, identifying 14 Risk Events and 22 Risk Agents via localized stakeholder engagement and digital sentiment analysis. Methodologically, integrating the Best Worst Method (BWM) into the standard HOR Multi-Actor framework successfully resolved traditional HOR limitations by factoring in decision-maker preference weights into the ARP and CARP calculations. Out of 6 prioritized strategies, the company management chose to immediately deploy the top three actions: PA 8 (KPI-based performance appraisal), PA 5 (regular mechanic training), and PA 1 (educational media development). This selection delivers an optimal, highly stable solution that balances operational urgency with the workshop's current financial and human resource capacities.

REFERENCES

Arifudin, O., Wahrudin, U., & Rusmana, F. D. (2020). Manajemen Risiko. Penerbit Widina.

Darmawi, H. (2006). Manajemen Risiko. Bumi Aksara.

Herowati, E., Surjani, R. M., & Ragacca, I. M. P. B. T. (2023, November). The House of Risk with Multi-Actor Approach Aligned with ISO 31000: 2018 for Effective Risk Management in Business with Risky Environment. *In 4th International Conference on Informatics, Technology and Engineering 2023* (pp. 326–339). *Atlantis Press*. https://doi.org/10.2991/978-94-6463-288-0_34

Mi, X., Tang, M., Liao, H., Shen, W., & Lev, B. (2019). The State-of-the-Art Survey on Integrations and Applications of the Best Worst Method in Decision Making: Why, what, what for and what's next?. *Omega*, 87, 205–225. https://doi.org/10.1016/j.omega.2019.01.002

Nasution, R. P., & Amin, M. (2023). Rancang Bangun Aplikasi Sistem Pendukung Keputusan Kenaikan Jabatan Pegawai dengan menggunakan Metode Multi Criteria Decision Making (MCDM). *Bulletin of Information Technology* (BIT), 4(3), 391–399. https://doi.org/10.47065/bit.v4i3.3912

Ristanović, V., & Knežević, G. (2023, January). Multi-Criteria Decision-Making on Operational Risk in Banks. In 1st *International Conference on Innovation in Information Technology and Business* (ICIITB 2022) (pp. 5–21). *Atlantis Press*. https://doi.org/10.2991/978-94-6463-150-0_2